assembled by ultrasonic welding or laser welding, the production cost may be decreased.

[0081] Hereinafter, an air conditioning apparatus to which a turbofan according to an embodiment of the present disclosure is applied will be described with reference to FIGS. **11** and **12**.

[0082] FIG. **11** is a perspective view illustrating a ceiling air conditioning apparatus in which a turbofan for an air conditioning apparatus according to an embodiment of the present disclosure is used. FIG. **12** is a cross-sectional view illustrating the ceiling air conditioning apparatus of FIG. **11** taken along a line **12-12**.

[0083] For reference, the air conditioning apparatus **300** as illustrated in FIGS. **11** and **12** is a ceiling air conditioning apparatus; however, the present disclosure is not limited thereto. The turbofan **1** according to an embodiment of the present disclosure may be used in various types of air conditioning apparatuses.

[0084] Referring to FIGS. **11** and **12**, the air conditioning apparatus **300** may include a housing **310**, a heat exchanger **320**, and a turbofan **1**.

[0085] The housing **310** is formed in a substantially hollow rectangular parallelepiped, forms an appearance of the air conditioning apparatus **300**, and is provided in a ceiling **350**. The bottom surface of the housing **310** is provided with an air inlet opening **311** which is exposed to the outside of the ceiling **350** and faces the suction port **23** of the turbofan **1**. Also, the bottom surface of the housing **310** is provided with a plurality of air discharge ports **312** around the air inlet opening **311**. A filter to filter incoming air may be disposed below the air inlet opening **311**.

[0086] The turbofan **1** is disposed in the center of the housing **310**, and is rotated by a motor **330** provided in the upper side of the housing **310**. The turbofan **1** includes the shroud **20**, the hub plate **10**, and the plurality of blades **30**. The structure of the turbofan **1** is the same as or similar to the structure of the turbofan **1** according to the above-described embodiment; therefore, a detailed description thereof will be omitted.

[0087] A bell mouth **340** for stabilizing the incoming air is provided between the shroud **20** of the turbofan **1** and the bottom surface of the housing **310** in which the air inlet opening **311** is formed. Also, a gap may be provided between an end **341** of the bell mouth **340** and portions of the plurality of blades **30** of the turbofan **1** facing the bell mouth **340**.

[0088] The heat exchanger **320** is provided so as to surround the turbofan **1** inside the housing **310**. The heat exchanger **320** cools the air by exchanging heat with the air passing through the heat exchanger **320**.

[0089] When the motor **330** rotates the turbofan **1**, a negative pressure is generated in the inside of the turbofan **1** so that the outside air flows into the suction port **23** of the turbofan **1** through the filter **314**. The air flowing into the suction port **23** of the turbofan **1** is discharged to the heat exchanger **320** provided around the turbofan **1** by the plurality of blades **30**. The air discharged by the turbofan **1** is cooled while passing by the heat exchanger **320**. The cooled air is discharged through the air discharge ports **312** of the housing **310**, thereby cooling a room in which the air conditioning apparatus **300** is disposed.

[0090] Hereinafter, improved performance of the air conditioning apparatus that uses a turbofan according to an embodiment of the present disclosure having a structure as described above will be described in detail with reference to FIGS. **13**A to **18**.

[0091] Performance of the air conditioning apparatus **300** receives much influence by the distribution of the air flow being formed by the turbofan **1**.

[0092] FIGS. **13**A and **13**B are views illustrating a flow of air in a blade of a conventional two-dimensional turbofan. FIGS. **14**A and **14**B are views illustrating a flow of air in a blade of a turbofan for an air conditioning apparatus according to an embodiment of the present disclosure. FIGS. **13**A to **14**B show results obtained by computer simulation.

[0093] Referring to FIG. **13**A, it can be seen that a lot of turbulence **150** occur at a separation point of the entrance portion **131** of the blade **130** of the conventional two-dimensional turbofan **100**. In the exit portion **132** of the blade **130**, due to the influence of the turbulence **150**, as illustrated in FIG. **13**B, the flow field of air is distributed in approximately half the height of the blade **130**.

[0094] However, in the turbofan **1** for an air conditioning apparatus according to an embodiment of the present disclosure, as illustrated in FIG. **14**A, compared to the conventional two-dimensional turbofan **100**, less turbulence **50** occurs at the separation point of the entrance portion **31** of the blade **30** by the effect of the curved portion **31-1**. In the turbofan **1** for an air conditioning apparatus according to an embodiment of the present disclosure, since the turbulence **50** occurs less, the flow field of air is distributed over substantially the entire height of the blade **30** in the exit portion **32** of the blade **30** as illustrated in FIG. **14**B.

[0095] The results of measuring power consumption and noise of the turbofan **1** according to an embodiment of the present disclosure and the conventional two-dimensional turbofan are shown in FIGS. **15** and **16**.

[0096] FIG. **15** is a graph comparing power consumption of a turbofan for an air conditioning apparatus according to an embodiment of the present disclosure and the conventional two-dimensional turbofan. FIG. **16** is a graph comparing noise of a turbofan for an air conditioning apparatus according to an embodiment of the present disclosure and the conventional two-dimensional turbofan.

[0097] In FIGS. **15** and **16**, measurement data of the turbofan **1** according to an embodiment of the present disclosure are measured after replacing the two-dimensional turbofan **100** of the air conditioning apparatus, which is provided with the two-dimensional turbofan **100** and is used in the experiment, with the turbofan **1** according to an embodiment of the present disclosure.

[0098] Referring to FIG. **15**, it can be seen that the power consumption of the turbofan **1** according to an embodiment of the present disclosure is decreased about 11% at the same flow rate as compared to the conventional two-dimensional turbofan. In FIG. **15**, P represents the power consumption (unit; W) of the turbofan, and Q represents the flow rate (unit; CMM) of the turbofan.

[0099] Referring to FIG. **16**, it can be seen that the noise of the turbofan **1** according to an embodiment of the present disclosure is decreased about 0.5 dB at the same flow rate as compared to the conventional two-dimensional turbofan. In FIG. **16**, SPL (sound pressure level) represents the noise (unit; dB) generated by the turbofan, and Q represents the flow rate (unit; CMM) of the turbofan.

[0100] As described above, in the turbofan **1** according to an embodiment of the present disclosure, the power con-